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SEISMIC DECOUPLING EXPERIMENTS

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NOTICES

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20 ABSTRACT *(Continue on reverse side if necessary and identify by block number)*

The seismic events monitored at the Nuclear Test Site in Nevada (NTS) during the contract period and the reports presenting the results of the data analyses for those seismic events are enumerated. Pertinent information about the events and analysis is summarized. The seismic events were DIAMOND MINE HE, MINE DUST HE, DIAMOND MINE of the MIGHTY MITE series, and the DIDO QUEEN event. For purposes of comparison, data from some other events were also used in the analyses.

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PREFACE

The work reported herein was performed by the Geophysics Section of the Environmental Research Institute of Michigan (ERIM), formerly the Willow Run Laboratories, a unit of The University of Michigan Institute of Science and Technology, for the Advanced Research Projects Agency under Contract No. F44620-71-C-0033. Inclusive dates of research were 15 December 1970—31 December 1973. The cost of the basic contract and three contract modifications totalled $165,893.

Lt. Col. Donald W. Klick of AFOSR (AFSC) was Program Manager for this work, while Rowland H. McLaughlin, of ERIM was Principal Investigator. Mr. R. R. Legault, a Vice-President of ERIM and Director of the Infrared and Optics Division, was Project Director, and Dr. David E. Willis of the University of Wisconsin at Milwaukee was the consultant. The ERIM number for this report is 197200-7-F.

SEISMIC DECOUPLING EXPERIMENTS

Final Report

1

INTRODUCTION

The contract this final report covers was initiated on 15 December 1970. Prior to that date ERIM's predecessor organization, the Willow Run Laboratories of The University of Michigan, had participated in the MIGHTY MITE series of events at NTS. This series continued in 1971 with the DIAMOND MINE and DIAMOND MINE HE events which were recorded and analyzed by WRL/ERIM as reported in Reference [1]. In that analysis [1] the data from the DIAMOND MINE and DIAMOND MINE HE events are compared with the earlier DIAMOND DUST event which occurred in May 1970 as part of the MIGHTY MITE series recorded and analyzed by WRL on a previous contract. Reference [2] describes the DIAMOND DUST effort. The subsequent MINE DUST HE event was also recorded; data pertaining thereto are presented in Reference [3]. Reference [4] comprehensively compares the seismic measurements taken in all four events.

During the last year of the contract a scheduled additional MIGHTY MITE event was cancelled, so the sponsor and ERIM agreed that the remaining funds would be instead used to record and analyze the data from another event, DIDO QUEEN, a nuclear shot. Though this was detonated in an area different from the MIGHTY MITE locations, the locale was one where efforts on a subsequent contract would be performed. A certain amount of continuity was thus afforded by the DIDO QUEEN event. Results of the DIDO QUEEN data recording and analysis are presented in Reference [5].

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TYPE OF ANALYSIS

To record ground-particle velocity, we employed, at each of the seismic stations, a three-component seismometer driving three seismic amplifiers. Multiple-gain outputs of these amplifiers were recorded on a seven-channel FM tape recorder together with WWVB time code radio signals. In subsequent analysis we used the time code signals to correlate and help identify the various seismic waves.

In one part of the analysis we displayed on an oscillogram, along with the time code, each component of ground motion for the event. From this record the travel time and, hence, average propagation velocity could be obtained.

In another analysis phase we determined relative energy in each of the frequency bands by subjecting each recorded electrical signal representing a particular component of ground velocity to a bank of one-third octave filters. Center frequencies of the filters ranged from 0.5 Hz to 100 Hz.

Additional site data were also recorded from which a velocity profile for each location could be determined. For this we set up a refraction line comprised of 12 seismometers distributed along a 125-ft linear distance. We then dropped a weight at both ends of this line while recording the response (output) of each seismometer. Such a refraction line was set up and recordings made at each of the five seismic stations in the MIGHTY MITE series. Utilizing the travel times determined from the recording, we obtained the required velocity profile data.

Other analysis involved implementation of a digital computer program to determine the spectral energy characterizing the various events in the seismic series. Here, the analog tape-recorded data were digitized and subjected to digital data processing. Reference [4] details the computer programs used and the results of our analyses.

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RESULTS

The several references cited herein document the complete results of efforts put forth on this contract. The results take the form of:

(a) M_D, m_b, and M_L magnitude comparisons
(b) Plots of spectral three-component particle velocities
(c) Plots of ratios of spectral three-component particle velocities
(d) Plots of spectral energy
(e) Particle velocity values as obtained and tabulated from other members of the Nevada Seismograph Net
(f) Seismograms

From Reference [4], the following conclusions were obtained:

(a) The geometric mean of the spectral ratios for the first compressional wave arrival and the maximum shear wave recorded at the five close-in stations indicated that the MINE DUST HE shot was a factor of 1.287 larger than the DIAMOND MINE HE shot.

(b) The ground velocity amplitudes measured from the broadband seismograms indicate that the MINE DUST HE shot was, at the mean, a factor of 1.32 larger than the DIAMOND MINE HE shot.

(c) Coda length magnitudes calculated for MINE DUST HE and DIAMOND MINE HE indicate that the MINE DUST HE shot was 0.23 magnitude units larger.

(d) The MINE DUST HE shot did not generate large enough signals to determine body wave magnitudes directly.

(e) The geometric mean of an energy ratio measure indicated that MINE DUST HE was 1.23 times larger than DIAMOND MINE HE; that DIAMOND DUST was 5.67 times larger than MINE DUST HE; that DIAMOND MINE was 6.32 times larger than DIAMOND DUST. These values are energy ratio values, so they are comparable to the squares of the velocity ratio values given above.

(f) There is evidence that tectonic strain release may have occurred at the time of DIAMOND MINE.

Additionally, Reference [5] contains independent conclusions relating magnitude values with event yield; these were made by cooperating organizations.

REFERENCES

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